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MALARIA, IRRIGATION, AND SOIL EROSION IN CENTRAL SYRIA

NORMAN N. LEWIS

THIS study of the Selemiya region of central Syria had its origin in a modest wartime public-health program. Hundreds of patients suffering from malaria in the villages of this district were regularly treated by a mobile clinic, and it soon became obvious that this work had to be supplemented if not replaced by swamp drainage and other measures of malaria control. The necessary investigations showed that soil erosion in the hills in the east of the region was partly responsible for the swamps on the plain. The swamps themselves were frequently associated with ancient irrigation works. Thus various problems of the region—agricultural, social, and medical—were closely linked in origin and development. It was found that attempts to solve any one of them alone could not be more than partially successful, and the conclusion reached was that the ideal solution would have to be radical, comprehensive, and on a large-scale regional basis.

The Landscape

The greater part of the governmental subdistrict (caza) of Selemiya is a plain. Bounding it sharply on the west are low plateaus, capped by a level bed of basalt a few feet thick; to the southeast are ranges of hills, part of the Palmyrene group, to which the local collective name of Jebel Bil'as may be given.

The ground slope over much of the region is toward the town of Selemiya; drainage from an area of 620 square miles converges on the low flat land around the town. Because of the continuous subsurface flow, a perennial stream rises at Ain ez Zerqa, to flow 12 miles to the west to join the Orontes. All other perennial streams, however, are only a few hundred or thousand yards long and are used for irrigation; most of them rise in artificial underground channels. Most of the watercourses are wadis, dry or nearly dry for much of the year. In the hills these are steep, V-shaped valleys, on the plain generally wide, shallow, gravel-filled channels in gentle, open valleys.

Figure 2 gives a simplified indication of the configuration. Hydrologically, the strata may be simply grouped into the Cretaceous limestones

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> Mr. Lewis, Scholar of St. Catharine's College, Cambridge, was in Syria during the war and is now principal instructor at the Middle East Centre for Arab Studies, Shemlan, Lebanon, a training center for British government officials in the Middle East.

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FIG. 1.—The Salamiya area in its general setting. The hills are frequently given the collective name of Jebel Bishri. Isohyets are from Charles Combier: Apercu sur les climats de la Syrie et du Liban, avec carte au millionième des pluies et vents, Délégation Générale de France au Levant, Beirut, 1945. Spelling of the place names here and in the text in general follows the (British) Permanent Committee on Geographical Names.

of the hills and the Eocene-Oligocene marl of the plain. The limestones are predominantly pervious dolomitic limestones, separated by more or less impervious beds of flint and marl. Winter rainfall runs off in the wadis or soaks into the ground and either is soon discharged at a lower level by temporary springs or seeps slowly toward the plain, assisted by the dip of the strata.

The marl of the plain is in its unaltered state impermeable, but usually it has been affected to a considerable depth by the percolation of water through cracks and fissures. In this way calcium carbonate and silica are deposited to depths of as much as 50 feet, and the whole character of the rock is altered.[1] It becomes crumbly, permeable, and water-bearing. Above this layer of rock a hardpan develops, ranging in thickness from a few inches to four feet, which is due to the concentration by capillary action of calcium carbonate and silica.

The region is one where the desert merges into the sown. The rainfall

[1] L. Dubertret: Lithological Map of the Eastern Border of the Mediterranean, 1:500,000, with notes translated by W. B. Fisk [i.e. Fisher], Fighting French Delegation General in the Levant, Geological Section, Beirut, 1943. 113

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IS ONE WHERE DESERT MERGES INTO THE SOWN. THE RAINFALL REGIMEN

regimen is Mediterranean in type, practically all the precipitation falling in winter, the summer being characterized by drought and great heat. In the east the rainfall is sporadic and unreliable and in most years is less in total quantity than in the west. Selemiya has a mean annual rainfall of 344 millimeters (13.5 inches). On the west-facing slopes of Jebel Bil'as rainfall is relatively heavy, though highly variable, and it permits tree growth. The present eastern limit of close agricultural settlement and of permanent unirrigated cultivation is near the 200-millimeter isohyet;[9] it was approximately the same in Romano-Byzantine times. Any further extension of agriculture to the east would mean great risk of crop failure and of increased soil erosion by wind and water.

In the cultivated west the soil is heavy and clayey, but farther to the east it is light and friable, with a high sand content and practically no humus. In Jebel Bil'as the soil is intermediate between these two types, liable to erosion by wind in summer and water in winter.

Over the greater part of the region the two main elements in the natural vegetation are low xerophilous scrub[9] and ephemeral grasses which appear in early spring and wither away in summer. The roots and rootlets of both the permanent scrub and the annual vegetation help hold the soil in place. In Jebel Bil'as these types of vegetation are well developed, and the hills are favorite spring pasture grounds for the sheep of peasants and Bedouins. Isolated trees grow in the Palmyrene ranges far to the east throughout the area within the 200-millimeter isohyet, and even just to the east of it, in country believed to have a mean annual rainfall of less than 200 millimeters (7.9 inches). On the northwestern slopes of Jebel Bil'as tree growth is more abundant. Nothing demonstrates better the positive rainfall anomaly of the hills as compared with the arid plains to the north and south.

At the present time the landscape of Jebel Bil'as is at the best parklike, the trees being scattered, except in the valleys, where clumps of three or four grow together. Few trees are taller than 20 feet. The *Pistacia* genus is represented by *P. terebinthus* (probably *P. palaestina*) and *P. vera* (the pistachio tree). The wood of these two trees, hard and slow-burning, is much valued as a fuel. Scrub oak also occurs, and in wadi bottoms thick-leaved evergreens. Shrubs and herbaceous plants are scattered everywhere.

Irrigation

The long summer drought makes irrigation necessary for most crops

[9] A full account is given by M. Zohary: Geobotanical Analysis of the Syrian Desert, *Palestine Journ. of Botany*, Jerusalem Ser., Vol. 2, 1940, pp. 46-56.

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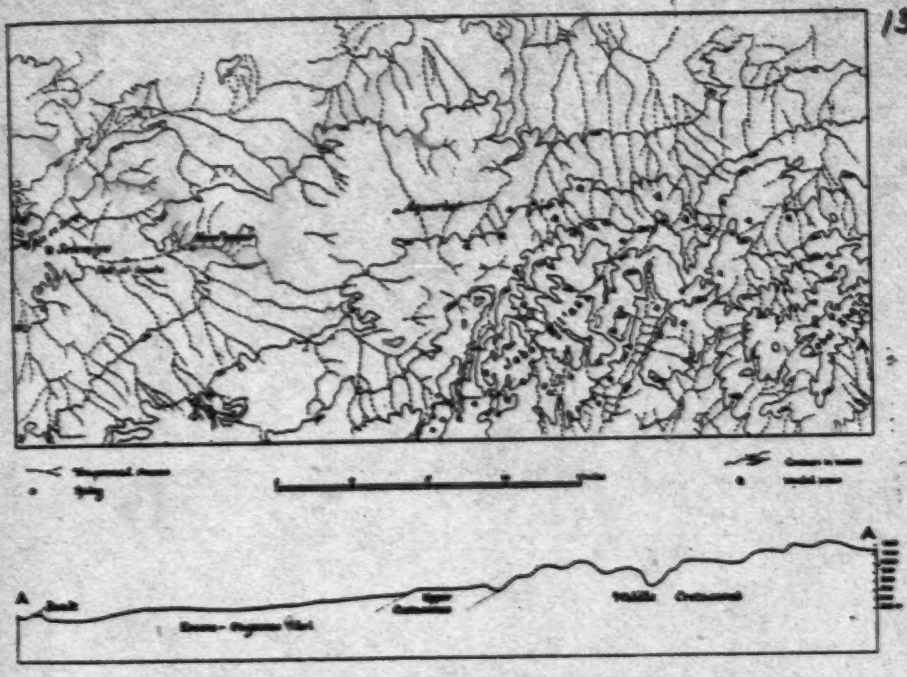

FIG. 2—Topographic map and cross section of the country east of Selemiya.

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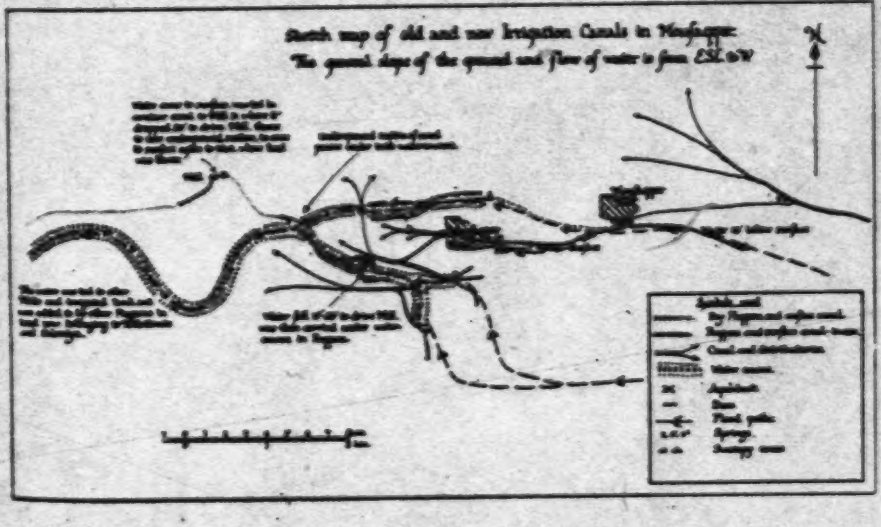

FIG. 3—The irrigation system of Mouflegar, east of Selemiya (see Fig. 2).

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except wheat and barley, and around each village is an area of irrigated land on which vegetables, fruit, cotton, maize, fodder, and grain are grown. The configuration of the ground and the peculiar properties of the marl make possible the use of subsurface water for irrigation, and past and present inhabitants have taken full advantage of these conditions.

Water is distributed to irrigation ditches from wells, surface watercourses, or *foggaras* (foqqaras).[3] It is lifted from wells either by pumps or by chains of buckets geared to an animal-turned wheel. From wadis which have water in part of their course for some or all of the growing season it is taken by a gravity canal. The stream is roughly dammed and the water led, at a gentler angle than that of the watercourse, along the valley side until it reaches a suitable level for watering the ground below. Neither of these methods is of great importance as compared with foggaras, which supply most of the irrigated lands of the area.

A foggara, known elsewhere as *qanat*, *kariz*, or "chain of wells," is an underground conduit. The method has been used since ancient times in many parts of the Middle East. Foggaras are found in several regions of Syria and are especially numerous in the Selemiya region. Figure 4 shows the general principle by which the water-bearing layer is tapped by the gallery or subsurface canal. The most copious supplies of water are provided when the canal is driven back from a spring along the underground "stream" that feeds it. A depression that is a natural gathering ground of water is often utilized, or a wide area may be tapped by the construction of several converging galleries, as in Moufaqqar. The gradient of the gallery is sufficient to induce water flow, but it is less steep than the general slope of the ground, so that water is conducted gradually to the surface, usually to low-lying flat land suitable for irrigation. The vertical shafts, like large wells, which connect the underground canal to the surface, were used during the digging as passages of ingress and egress and serve the same purpose now when the canals are cleaned of mud, debris, and vegetation; hence they are always surrounded with mounds of accumulated spoil. Lower down, as the canal comes to the surface, it flows between steep banks, which gradually become less high, until the water is flowing at ground level. Often the hardpan forms a natural roof to the gallery.

In length, depth, and water flow the foggaras differ greatly. One canal

[3] Foggaras in North Africa have been described and illustrated in the *Geographical Review*. See Jules Blache: Modes of Life in the Moroccan Countryside, Vol. 11, 1921, pp. 477–502, references on pp. 488 and 491; R. H. Forbes: The Transsaharan Conquest, Vol. 33, 1943, pp. 197–213, reference on p. 199—Edit. Note.

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FIG. 4—Vertical section of a foggara. The diagonal shading represents the water-bearing level in the altered marl, below which is unaltered impervious marl. The gallery A to B taps the water-bearing layer at its upper end and in the center. Water in the gallery is represented by the dashed line. The irrigated area extends from B to C. The vertical shading represents the part of the canal between steep banks.

FIG. 5—Upper part of one of the Moufaqqar canals (see Fig. 3). Photograph from a position corresponding to B above, where the canal is formed by steep banks. Parts of natural roof are formed by the hard pan, clearly distinguishable from the bed of crumbly altered marl below. Until 1945 the canal was semi-derelict, filled with mud, vegetation, and flood detritus (see foreground). When the cleaning was completed, the canal was approximately doubled in depth and a strong stream of clear water flowed in the bottom. (Photograph by John Gough.)

was built, probably in the Roman period, to carry water from Selemiya to Apamea, more than 50 miles away. This was an exception, dug to carry drinking water to a city, but some of the canals which capture and supply irrigation water in the Selemiya plain are several miles in length; one, starting in Moufaqqar, was originally seven miles long. Others are only a few hundred yards in length.

The quantity of water delivered by the canals in use today is estimated

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312 locally by the area of land each irrigates. One canal irrigates 136 acres near Selemiya town; many supply between 20 and 60 acres; and the smallest suffices only for 2.4 acres (near Tell et Tout). The larger canals are nearly all in the low-lying basinlike plain around the town of Selemiya; most of the smaller ones lie toward the northeast. A canal which supplies 68 acres of land in Selemiya delivers 8.8 gallons a second (measured at lowest water level, in October, 1945). There are today in the caza 125 such canals which are in working order and an unknown number which are not in use. These 125 canals irrigate a total of 3060 acres. The map of Moufaqqar (Fig. 3) shows typical modifications and elaborations of the foggara.[4]

History

175 312 At Misherfe-Qatna, where a modern village occupies the site of a Hittite fortress-city, 18 miles southwest of Selemiya, a foggara-like canal supplied the town in the second millennium before Christ.[5] Most of those in our region date from a much later period, and probably more were constructed from the second century of our era to the sixth than at any other time. Many can be dated by the details of their construction, or by their close association with ruins, or, occasionally, by inscriptions. During these centuries the Selemiya region was a prosperous agricultural district, well supplied with irrigation water. The Roman legacy was added to in the early period of Arab rule,[6] when Selemiya was well known as a pleasant country town, the public buildings of which, especially the baths, rivaled those in great Arab cities. Descendants of the Abbasid Prince Saleh ibn Ali ibn Abdullah ibn Abbas ibn il Motalib lived in Selemiya, and, according to Ya'qubi, writing in 891, Abdullah, the son of Saleh, "conducted thither a stream of water, and dug wells in the land, whereby the saffron grows plentifully." For a period after 893 the town became a center of the Ismaili sect, a circumstance which brought it importance then, and which was to affect the region powerfully a thousand years later.

Throughout the Arab period the water of Selemiya remained famous. As late as the fourteenth century Ahmed the Secretary praised Selemiya as "a charming and rich town, with abundant water and trees. Water comes

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[4] See the maps of Qdeym for typical modifications and elaborations of the foggara, Plate III and IV in the atlas volume of R. Mouterde and A. Poidebard: Le limes de Chalcis: Organisation de la steppe en Haute Syrie romaine (Bibliothèque Archéologique et Historique, Vol. 38), 2 vols. (text and atlas), Paris, 1945. See review elsewhere in this number of the *Geographical Review*.

[5] Memil du Buisson: Le site archéologique de Michrife-Qatna, Paris, 1935.

[6] Information on the Arab period is drawn largely from the article "Salamiya" in the Encyclopaedia of Islam and from Guy le Strange: Palestine under the Moslems, Boston and New York, 1890. The quotation from Ya'qubi is from Le Strange, p. 528.

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to it in aqueducts."[7] Today there are 39 foggaras in use on the lands of Selemiya, and there are also some that are unused. Very few of the foggaras are modern, so that we may legitimately suppose about the same area to have been irrigated around the town in the Arab period as at present—1300 acres. The water was renowned for its purity, as it is today, and Hama, 18 miles away on the muddy Orontes, drank Selemiya water brought to the city by a foggara from Ain ez Zerqa. Abu el Fida (1273–1331), geographer and king of Hama, caused this canal to be cleaned, and two centuries later the following inscription from a Hama mosque shows that it was repaired or cleaned again:[8]

> On fifteenth Gumada I 901 [March 2, 1496] was promulgated the princely, august decree of our master, the great emir, the chief, the governor general, Sayfiddin el Asrafi Qansuh as Sarifi as Sami, governor general of the province of Hama (may God glorify his victory!), prohibiting the diversion of moneys to the profit of the exchequer (may it ever prosper!) and of others, from the funds intended for the aqueduct of Selemiya, and ordering that nothing should be taken from this fund except the wages of the workmen laboring on it. Whoever should renew these exactions, let him be accursed, and may both his father and his Prophet testify against him on judgment day.

By this time the prosperous days of Selemiya were nearly over. Scattered references show that the frontier of settlement and regular agriculture in the region was retreating westward. Tamerlane ravaged all Syria in 1400, and in 1516 the country fell to the Turks. During the next four centuries Syria slowly decayed. In the seventeenth and eighteenth centuries several great Bedouin tribes moved north out of Arabia into the Syrian Desert and its peripheral regions. After this the steppe and the desert were almost completely beyond the control of the Turkish government, and the frontiers of law, order, and settled life retreated from the edges of these uncontrolled territories. The valuable journals of some English merchants[9] who traveled through the eastern part of our region at the end of the seventeenth century show that, except for Bedouins, it was then practically deserted. The Ismaili inhabitants, according to their descendants' tradition, had left soon after

[7] See [Maurice] Gaudefroy-Demombynes: La Syrie à l'époque des Mamelouks (Bibliothèque Archéologique et Historique, Vol. 3). Paris, 1923, pp. 77–78.

[8] This inscription is from the Great Mosque of Hama, where there are a number of Mameluke decrees, dealing particularly with trade and taxation. It is transcribed in French by Jean Sauvaget in *Bulletin d'Études Orientales de l'Institut Français de Damas*, Vol. 3, 1933, p. 6.

[9] "An Extract of the Journals of Two Several Voyages of the English Merchants of the Factory of Aleppo, to Tadmor, Anciently Call'd Palmyra," *Philos. Trans. Royal Soc. of London*, No. 218, Vol. 19, 1695, pp. 129–147. [Also in "Miscellanea Curiosa," Vol. 3, Containing a Collection of Curious Travels, Voyages, and Natural Histories of Countries, As They Have Been Delivered in to the Royal Society, 2nd edit., revised and corrected by W. Derham, London, 1727 (originally edited by Edmund Halley in 1708), pp. 120–159.]

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175 Tamerlane's invasion and were dispersed in other parts of Syria. Of 3200 villages once on the tax rolls of the pashalik of Aleppo, only 400 were said to be inhabited when Volney visited the country in the 1780's.[10] Such peasants as remained in the west of our region suffered from misgovernment, extortion, and raiding by Arab tribes.

166 In the second half of the past century a movement of recolonization [231] started that is still in progress. Sheep-raising Arab tribes began to settle in 361 villages; peasants came from the districts of Hama and Homs; immigrant 795 Circassians established four villages north of the town of Selemiya. The 312 frontier began to move outward once more, and old foggaras were cleaned 241 and repaired to give irrigation water once again. The strongest and most energetic immigrant group, the pioneers, were Ismaili, led back to their land of a thousand years ago by a group of powerful leaders. They settled first on the site of Selemiya itself about 1870. Today they number 14,000 or more, the majority living in the town and in villages to the east. They chose village sites where old foggaras could be brought into use, and for 75 years they have been extending the area of irrigated land by the restoration of old canals and the digging of new ones. In the last 20 years subsistence agriculture, depending largely on unirrigated grain farming, has given way before a more intensive commercial system, typified by the growing of irrigated cash crops such as seed onions and cotton on individualized holdings. [657] The government has granted money for canal cleaning and swamp drainage. All these factors have contributed to extension of irrigation.

312 Some old canals, however, are still derelict. Some are so ruined that the [464] cost of repair would be prohibitive. Others may yet be brought back into use, but the will to work is weaker than in the early days of colonization, and now laborers' wages and other expenses have increased. Elsewhere village boundaries cut across old canals. Landowners of the village where a canal rises are loath to let the water flow away to the lands of another village, and thus ancient foggara systems which were perfectly related to the physical environment have been partly replaced by more local schemes of surface canal and ditch irrigation. For example, the canals that rise in Moufaqqar (Fig. 3) could irrigate land and drive mills in Moufaqqar, Tell et Tout, and Selemiya, but they have been so modified that the water is used only in Moufaqqar, and some of it runs to waste. A canal which rises in Tell et Tout but which formerly flowed on to Selemiya land has been blocked, so that its water irrigates Tell et Tout land only.

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113 [10] C.-F. Volney: Travels through Egypt and Syria, in the Years 1783, 1784 & 1785, translated from the French, 2 vols., New York, 1798; reference in Vol. 2, pp. 90–91.

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Malaria and Its Control

Foggaras and surface canals easily become partly blocked by vegetation, and floods and rain wash in mud and silt. The water is then ponded back, depressions near the canal bank fill, the canal may overflow, and, if it is built along the side of a valley, overflow or seepage will maintain swamps along the watercourse. Artificial blockages of foggaras also pond back the water. Near the lower end of most canals are "brick pits" from which earth has been taken to be made into mud bricks, and these also tend to fill with water. Everywhere wadis carry rain and seepage water in winter and spring and the overflow from irrigation canals in early summer and autumn, at which seasons there is a surplus. In other words, except during the peak irrigation and evaporation period of midsummer, they carry slow-moving, half-stagnant water.

All these places are potential, and most of them actual, breeding places of the mosquito *Anopheles sacharovi*, which favors shallow, sunny, warm waters, full of aquatic vegetation. At only one place in the area has another malaria carrier, *A. algeriensis*, been found, and the problem of malaria control in the region is thus essentially that of eliminating the *A. sacharovi* breeding grounds. Full statistics are not available, but such figures as do exist show the great need of such control. About 20 per cent of the patients treated by a mobile clinic in the region in 1942–1945 were suffering from malaria, and the percentage rose at times (especially in late summer) to 80 in some villages. Sometimes practically the whole population of a village was found to be infected. In Tell et Tout (population *c.* 550) about 50 deaths were due primarily to malaria in 1941, and almost the sole source of infection was the swamp caused by the deliberate blockage of a foggara.

Control work is apparently simple. Canal owners occasionally clean the canals of detritus and vegetation and repair the banks at the lower end. It is important that this work be done well and repeated every few years. Small depressions may be sprayed, filled with earth, or drained by a simple ditch. Broad, sluggish streams may be canalized by a ditch along the thalweg. The more efficient the irrigation, the less likely it is that mosquitoes will breed. Waste of water should be reduced to a minimum and a wide range of crops grown, so that irrigation begins early in the season and ends late. The "waste" water of natural watercourses may be utilized by the construction of a simple dam and gravity canal, or by the repair of the old subparallel foggara if, as is probable, there is one. Extensive stretches of swampy ground may be put to good use by drainage-irrigation schemes, which often include the repair of old foggaras. Malaria control should not stand on its own, an expensive

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necessity for health's sake alone, but should be part of a general *mise en valeur* of the region's resources. This is the type of approach which is most likely to succeed, because it is linked with the material interests of the landowners. They will lend their support and active participation if given technical advice, supervision, and material and financial help to defray part of the capital outlay.

Swamps, Floods, and Soil Erosion

Malaria-control measures were taken with a fair degree of success in 20 villages in 1944–1945. Various factors, however, combine to prevent a permanent reduction of the incidence of the disease. Among these are the necessity for constant supervision, the need for repeated cleanings of canals and ditches, and the improvidence of the inhabitants. Most important is the fact that floods will certainly undo much of the work.

Winter floods are frequently heavy enough to destroy or damage seriously the repair and maintenance works, which are of value to agriculture and malaria control alike. Malaria causes debility and apathy among the villagers, and the certainty that floods will recur reinforces this apathy, making everyone disinclined to expend energy and money in work which must be done again in a few years. The canals and watercourses at Moufaggar, for example, have been badly damaged in the past; in fact, damage by floods was the main reason for the modification of the old foggara system. The southern foggara and watercourse are now protected against torrents by a concrete wall at the upper end, but as the system lies in one of the main valleys coming from Jebel Bil'as, it is doubtful whether the device will be a great success. Although the broad, nearly flat valley north of Selemiya has benefited from its wide catchment area—it is built up of alluvium, as much as 10 feet deep—it is partly derelict because floods have created extensive swamps and ruined old foggaras. In 1945–1946 useful drainage work was undertaken here.

The floods are due in part to the occasional sudden and torrential rainstorms, characteristic of this as of other semiarid regions. Wadis are sometimes filled for a few hours with violent, detritus-laden torrents and are then left dry again. The steep slopes and absorptive limestones are contributing factors. English merchants, traveling in 1691, noted[11] that after a heavy rainstorm

> those hollow Gutts which we passed over without the least appearance of Moisture, were, by the Cataracts which descended from the Mountains, become Rivers; . . . the next Morn-

[11] "An Extract of the Journals" (*op. cit.*), p. 144 [Manchester Curiosa, pp. 139–140].

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ing all this great quantity of Water was past away, so that in about two Hour's Riding we could hardly perceive that there had been any Rain at all.

That floods are an old phenomenon in Selemiya is suggested by two traditional theories, repeated by the inhabitants today, regarding the derivation of the place name. The first theory makes the essential form Sal-Miah, "a flood of water." The other was recorded by Yaqut in 1225:

> Ahmad ibn Yahyā ibn Jābir relates that there was a city in Syria, near Salamiyyah, called Al Mūtafikah [The Overturned], which was overwhelmed with all its inhabitants—all except one hundred souls. These left that place, and came and built one hundred houses, and they called the hamlet where they had made their houses Salām Miyah (Peace for the Hundred), of which the people made Salamiyyah.[22]

As told today, the story is that the "overwhelming" agent was a flood.

The floods are greatly aggravated by soil erosion. Where the trees have been cut, the bushes torn up for fuel, and the grass overgrazed, and especially where slopes have been plowed, there the soil is eroded, and many slopes are now practically bare of soil and vegetation. In summer, soil is shifted by strong winds; in winter, rain washes it into gullies or wadis with steep, crumbling sides. These are tributary to the main streams which do so much damage when they reach the plain. The runoff from bare slopes is faster and more fully loaded than that from vegetated slopes.

Past and Present Vegetation Destruction

There is no doubt that the trees of Jebel Bil'as are a remnant of a denser and more extensive growth, though there are no very good grounds for the common assumption that all the Palmyrene ranges were forested in Roman days. The Tablet of Palmyra's fiscal laws of A.D. 137[23] gives reason to suppose that the locality may have furnished considerable quantities of wood and pistachio nuts, and in the same period Jebel Bil'as and neighboring ranges were used as grazing lands for sheep and horses.[24] The location of elaborate Romano-Byzantine foggara systems, as at Moufaqqar, directly in the paths of the floods might seem to indicate that, when the foggaras were constructed, floods were not as serious as they are now.

Old stumps and roots are found within and beyond the present wooded

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[22] Le Strange, *op. cit.*, p. 510.

[23] See J.-B. Chabot: *Choix d'inscriptions de Palmyre*, Paris, 1922, pp. 23–32.

[24] A. Poidebard: *La trace de Rome dans le désert de Syrie.—Le limes de Trajan à la conquête arabe.—Recherches nouvelles (1925–1932)* (Bibliothèque Archéologique et Historique, Vol. 18), Paris, 1934; M. D. Schlumberger: Une campagne de fouilles au Djebel-el-Cheer en 1934, *Comptes Rendus de l'Acad. des Inscriptions et Belles-Lettres*, 1935, pp. 250–256.

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area. The English merchants who passed through the hills in 1678 noted that Jebel Bil'as was "covered with Trees, which, for the most Part, were the small *Pistacho*'s which the *Arabs* pickle with Salt; but eaten green, are good to quench Thirst"; and in 1691 they ascended a ridge to the east of Jebel Bil'as where the tree cover is now sparse and found it "cover'd on both Sides with great plenty of Turpentine-Trees," which grew "very thick and shady," several of them "loaded with a vast Abundance of a small round Nut."[15]

In spring, when surface water is available and the pasture is excellent, the hills are full of flocks; and several hundred thousand sheep, together with some goats and camels, pasturing each year for about three months cause much damage. Bedouin and peasant shepherd families burn vegetation on the spot, and woodcutters from Selemiya and the villages cut large amounts of the valued slow-burning pistachio wood. Vegetation has been destroyed in these ways since prehistoric times, but at certain periods the process has been quickened. Between 1914 and 1918 the Turkish authorities took great quantities of wood as fuel for the railroads. Local notables say that within living memory trees extended beyond Aquerbat; that is, several miles into the country now cultivated and treeless. The westernmost range, Jebel Shomariye, has lost all its woods, and a ridge to the east, which was "overgrown in some places" with terebinth trees in 1908,[16] is today bare. A new danger to the soil of the hills has resulted from the high grain prices now prevailing, the growing population pressure in the region, and the tendency of Arab tribes to settle down to agriculture; for now increasing areas of land on the western fringe of the hills are being plowed.

Malaria control on the plain must clearly be accompanied by soil conservation in the hills, and, ideally, both should be part of a larger scheme of regional rehabilitation. Such a scheme would cover, among other matters, irrigation, malaria control, vegetation conservation, farming practices, and grazing rights. It would mean radical changes in the region; it would require a large capital outlay; and it would necessitate government action of a scale and vigor practically unknown in Syria. It is impossible to discuss here whether such a scheme would be economically justifiable, or possible within the present social and political framework. One can only emphasize that some such comprehensive action must eventually be taken if the problems of the region are to be solved.

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[15] "An Extract of the Journals" (*op. cit.*), pp. 132 and 143 [Miscellanea Curiosa, pp. 123 and 137–138].

[16] Alois Musil: Palmyrena, *Amer. Geogr. Soc. Oriental Explorations and Studies No. 4*, 1928, p. 44.